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ABSTRACT

A model for dealing with ordinary, cortically-mediated behaviors is presented. The model's foundation is the set of motivational systems existing in the mature organism. Construction of the model follows the stimulus-response paradigm as interpreted by recent physiological research. The purpose of the model is that it requires a multivariate analysis of behavior. The operation of the model is described in analysis of the processes of attitude change. Four processes which have the characteristic of attitude change are identified. Particular reference is made to change concepts presented in communication research. (Author)

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A MODEL FOR CORTICALLY MEDIATED BEHAVIORS: A "NEW THINK" MODEL FOR SOME OLD THOUGHT PROCESSES.

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THE MODEL ITSELF

The purpose of this paper is to present a model which will be useful for dealing with ordinary communication behaviors and will not be dissonant with the more or less accepted concepts of communication research. There has been no attempt to justify the model through the selection of appropriate (supporting) studies in various disciplines. The success of the model, therefore, depends on its usefulness not on evidentiary support. According to this author, the particular contribution of the model at hand is that those using it should be forced into multivariate analysis of human behavior.

Before beginning a discussion of the model, two assumptions must be stated: The model is useful for dealing with ordinary--non-crisis behavior. It does not appear useful for dealing with reflexive or high intensity behavior where normal mediation does not occur. Second, the model assumes a mature organism defined as one which has passed through the major portion of an enculturation process and is now a functional member of its society. One final caveat. Social scientists are presently at the threshold--perhaps still wrestling with the door handle--of their science. Much of the evidence for the way organisms behave and the effects of various influences is at least weak and probably suspect. One of the characteristics of the educated man is that he can suspend judgment until reasonable doubt is erased. You and I may not be able to render judgments within the behavioral sciences in our lifetime. Rather, we should approach the evidence pragmatically; did it solve a problem; will it solve others.

Reading from left to right, we begin (although the modeled behavior does not!) with the matrices of available stimuli, external and internal. External

stimuli available at any moment are presumed to be infinite in number; internal stimuli probably are not. External and internal stimuli are received by their appropriate receptors. External receptors are vision, audition, and so forth; internal receptors are kinesthesia, somatic systems, motor systems, and so forth. Information from the sensory receptors is fed into the receptor's relay agents. These agents change the information by chunking it (many receptor cells feed into a single nerve fiber) and probably by providing first level interpretations of the data. The sensory information passes through additional relay agents (in vision, the lateral geniculate body) before arriving at the cerebral cortex which we have identified as the central processing agent. Relay agents appear to have afferent and efferent connection with the cortex. Consequently not only is information passed on to the cortex, but information can be returned. That information can be sent to the relay agents, allows us to postulate a pre-setting or sensitizing of the relay agents, making them more likely to pass certain information and less likely to pass other information. This pre-setting allows the organism to more efficiently meet its needs and at the same time to protect itself from disruptive information. It is hypothesized that three judgments are concluded in the relay agents. These judgments are termed the identification process. The judgments involve the continua of known--unknown; positive--negative; relevant--irrelevant. Known--unknown operates as a early warning system. When the environmental (internal and external) information is essentially unknown, ordinary behavioral patterns are abandoned and investigatory, fear, and/or flight behaviors are evoked. Similarily information which is exceedingly positive (reinforcing for the organism) or negative (punishing) evokes instantaneous shifts in motivations which introduces a short-circuiting of normal behavior patterns. In the normal course of events the organism is operating in a known environment

whose events are neither highly positive nor negative. It is the last continuum (relevant--irrelevant) which influences most behavior. Relevance is defined by the operating motivational systems. Given a dominant set of motivational systems, a given set of information will be more useful to the organism. The relay agents and very likely the CPA are pre-set to deal with information relevant to the motivational state and to gate out irrelevant information. Changes in the motivational state result in changes in admissible information.

Information is passed from the relay agents to the central processing agent which evaluates it in terms of the requirements established for reinforcement by the motivational systems using stored information relevant to the systems. This process is the final step in the development of meaning for incoming information. The meaning applied initiates the actions of storage (all meaning units--interpreted stimuli--are probably stored, at least, in short term memory), evocation of some response, or evocation of reinforcement.

It is the motivational systems which provide the basis for the activities of the relay agents and the central processing unit. Motivational systems are composed of pre-formed and post-formed systems. Pre-formed systems (e.g., the limbic system) are indigeneous to the organism and correspond to the primary drives, instincts, intrinsic motivations, critical periods, and so on that have been introduced in the literature. Post-formed systems develop through the interaction of the organism with his internal and external environment[1]. Post-formed systems correspond to secondary drives, needs, values, beliefs, and so on and are probably composed of clusters of "associational" neurons in the cortex. Both pre-formed and

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[1]Development has been speculated to result from the consistent association of a given response with reinforcement of some pre-formed system. Over time that response set becomes self-motivated.

post-formed motivational systems have three functions. a) They set the activity level of the organism; b) they establish the conditions for reinforcement; c) they define (by (a) and (b) above) the realm of activity by raising the probability of certain responses. Activation level of the system is probably a function of the ascending reticular activating system and similar structures. The conditions of reinforcement are determined by the deprivation levels of the motivating systems. At any given moment all systems are in some state of deprivation ranging from zero to 100 per cent. Particular classes of stimuli are required to trigger reinforcement. These classes are not necessarily complimentary but are more likely to be competitive. These competitive requirements allow for shifts in behavior as one system attains satisfaction and another system becomes dominant. This concept is the basis for the third function--setting the acceptable realm of activity. It suggests that the more equivalently deprived motivational systems an individual has the wider the variety of behavior will be produced. And, obversly, the greater the state of deprivation of a given system the more narrow the acceptable range of behaviors will be. In order for the organism to efficiently provide the triggering meaning units for reinforcement, the motivational systems provide a series of pre-setting actions. They pre-set the relay agents to be sensitive to certain information bytes and to ignore others. They raise the likelihood of retrieval of relevant stored information. They establish expectations within the central processing unit for dealing with this information. They raise the likelihood of certain responses in the response hierarchy. And finally, they ready the action of the appropriate reinforcement centers. This pre-setting is, of course, as multi-dimensional as the number of non-satiated motivational states.

It is this author's presumption that motivational systems can vary in deprivation and power with power being some function of size or influence.

Satiation of powerful motivational systems preceeds satiation of weaker ones given the availability of reinforcement bound stimuli.

Moving on in the model, should the central processing unit determine that some response is called for, the currently successful response is evoked from the pre-activated hierarchies. There are a number of difficulties in dealing with behavior: a) It is continuous; b) it can be multiply-motivated; c) consequently it can be directed toward multiple goals; d) and it is not totally observable either to the organism producing it or to others. The social scientist must break behavior into discrete units; sort out the motivations and goal; and determine the behavioral units essential to an analysis. It would be exceeding useful if the behavioral scientist could discover a behavioral molecule. As in Chemistry, where the molecule is the smallest unit which can be combined, the behavioral molecule would be the smallest unit of behavior which can be evoked and reinforced. These molecules of behavior, then, combine to form behavioral compounds.

Even in the absence of support it is useful to consider behavior as being stored in molecular form. A given meaning unit then would evoke a set of behavioral molecules which would form the compound behavior we observe. The particular compound formed would depend on a) the available molecules; b) the nature of the incoming information and; c) the operating motivational set. Innovative behavior is easily explained by the evocation of an unusual compound of behavioral molecules. Consistent behavior in spite of no two sets of incoming information being exactly the same is explained by the inability of the central processing unit to discriminate differences among highly similar information sets in the interpretation processes. Behavior when generated provides both internal and external stimuli (always internal stimuli). Further it establishes expectations of what the behavior itself should be and what the results of the behavior should be. In support of

the first contention, we continuously make discriminations among clumsy and graceful responses. For the latter contention, without expectation of result, there would be no basis for the selection of a given response.

Our last step in our model is the reinforcement agency. When the central processing agent determines that the conditions for reinforcement have been met, reinforcement (positive or negative) activities are evoked from the appropriate reinforcement center. In many of the writings on behavior, reinforcement has been posited as the reduction of a need--the satiation of a motivational system. There is, of course, a parsimony in this definition since the number of operating agencies is reduced by one set. Nevertheless, physiological evidence for reinforcement centers is growing. In either case, whether by separate centers or by the motivational systems, reinforcement does occur, selectively, mediated at least in part by the CPA. In the model, reinforcement is provided to the motivational system served, the response center, the CPA, and the relay agencies. The full operation of reinforcement with its positive and negative directions and its selectivity is unknown although much has been inferred as a result of S-R experiments. Reading those experiments one may come away with a feeling that reinforcement is automatic and beyond the control of the organism. Again physiological evidence is mounting that many of the operations once considered beyond the "conscious" control of the organism (e.g., heart rate, oxygen demand) are, within large ranges, subject to conscious control. In our model we have postulated cortical mediation of reinforcement. Reinforcement only occurs, then, when the requirements for reinforcement are judged by the organism itself to have been met. Now, the facts of common physiological structure and common culture allow us to make pretty good guesses as to the reinforcement requirements of a given organism in a given motivational state. But even so, our guesses have been primarily successful only with the more powerful moti-

vational systems in relatively high deprivation states. For example, we are fairly successful in modifying the behavior of a mammal which has been deprived of food for 24 hours by giving it something to eat. We are a lot less successful in modifying the behavior of that now hunger satisfied mammal by telling it that a new behavior would be good for it.

Examination of the entire model brings two issues clearly home. First of all the organism operates in essentially a closed system. Stimuli are only stimuli when interpreted by the organism. Response effect--positive or negative reinforcement--is also defined by the organism. The organism is perfectly capable of denying contact with reality outside of itself. No external force can guarantee behavior. In the normal course, however, the mature human organism has contact with an outside reality and in a manner that he has been trained to do so. This training we call culture. Culture determines the areas of contact and the style of contact within those areas.

The second issue revolves around the organism's sensitizing and gateing procedures. These procedures serve to maintain the major psychological structures that have developed in the mature organism. These structures have developed presumably because they successfully deal with the problems the organism meets. Changes in these structures would occur only if they become no longer successful. Such failure is painful to the organism and new structures would therefore be sought. The issue, then, is that the organism operates to maintain the status quo and that change in the status quo is associated with pain. By change we, of course, mean change in the major structures, i.e., values, beliefs, enculturated responses, and so forth which define the individual qua an individual. Change in these structures is painful as the period of change is a very inefficient period with conflicting motivations and responses. If change is painful, then change will only occur when the pain of continuing in the status quo is greater than the pain of

change. We would expect, then, personality changes to be preceeded by mania/depression, tension, and so forth. We would not expect personality changes under conditions of relaxed well-being.[2] The point of this discussion is that if we postulate that the organism is first protective of its present state and second that change is painful, we must immediately scale down our expectations in regards to the effect of external sources on modifying behavior.

We are now ready to look at the operation of the model which will be described in part in the following section. This section deals with the model in special reference to attitude change.

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[2]Some argument is expected from Rogerian theorists and/or Eastern aesthetics who postulate geniune change in tranquility and reflection.

ANALYSIS OF THE OPERATION OF THE MODEL

WITH SPECIAL EMPHASIS ON ATTITUDE CHANGE

Quickly reviewing the model, behavior begins with the action of the motivational systems. The motivational systems first provide activation, then, define the acceptable realm of activity by virtue of the relative states of deprivation. The motivational systems pre-set the relay agents to pass only that information relevant to the deprivation conditions. They raise the probability of return of certain stored information and they provide the decisional basis for the central processing agent in its evaluation of incoming and stored information. They therefore establish a "need" condition in the CPA for certain kinds of data. They also pre-set the response mechanism by the probability of certain response sets. In like manner they pre-set the reinforcement centers. These activities make the organism more efficient by reducing the latency (the time between stimulies and response and the time between response and reinforcement) periods. Finally, they define the conditions for reinforcement. These conditions are a function of the deprivation states and the indigeneous and learned responses which are associated with reinforcement.

At any given moment all the motivational systems in the organism are in some state of deprivation ranging from zero to 100 per cent. The greater the state of deprivation and the more significant the system the more effect a given system will have. Obviously many of the systems will be making demands on the organism at the same time. Some of these demands will be complementary, others in competition. These demand sets results in the rich

variety of behaviors we observe in even "simple" organisms[1]. The balancing of these demands may also account for innovative behavior as an unusual mix of requirements would result in a new "compound" of behavior.

We can now take our model and apply it to the concept of attitudes and attitude change. Attitudes are inferred from the consistent presentation of a behavior given the same stimulus set. In our model we can see that the stimulus is perhaps less important than the meaning applied to it as a function of the motivational set operating. Stimuli received under different motivational conditions will receive different meanings and different behavior may result. It is therefore inadequate for a researcher to generalize about the conditions of attitude change unless he can specify the motivational conditions under which his subjects were operating. Much of what we now call "attitude change" may equally be "meaning change". The importance of this concept is that it demonstrates that an individual's responses to an attitude object can be consistent but dissimilar from time to time given the operation of different motivational systems. Consequently, stimulus Y under research conditions may produce behavior X but under "real life" conditions stimulus Y evokes response Z as a result of the operation of different motivational sets. As every communication researcher knows, messages persuasive in the laboratory usually become unpredictable in the "real world".

True "attitude change", i.e., change of behavior given the same stimulus and motivational mix, can occur through two processes. In the first the associational bond between the meaning unit set (interpreted stimuli) and the original behavior unit set is broken and a bond between the unit set and a new behavioral compound is established. This change is most likely to occur when the response is inefficient. That is, the response results in

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[1]The reader may remember a plenarian study where "boredom" was introduced as an explanation of unpredictable behavior.

a low level of reinforcement for the particular motivational set. The sources of inefficiency are several. The response may for example provide only partial reinforcement for the major motivational system functioning or total reinforcement for one of the minor systems. The response might also be inefficient in that there is a long latency period from the time of the response until the conditions (subsequent stimuli) for reinforcement have been met. The response might be difficult to produce requiring a large number of steps or precise sequencing and so forth.

Under these conditions of inefficiency, the organism is ripe for change. The more efficient the response, however, the less likely the organism is to change. Evidence contrary to this principle, reinforcement studies which show behavioral change under conditions of continuous reinforcement, can more easily be accounted for by postulating changes in motivational set than in arguing changes of reinforcement functions.

The organism is always seeking methods for efficiently meeting the demands of the motivational systems, curiosity behaviors and play (in the immature organism) are probably functions of the drive for efficiency as the organism with a large repetoire of response is more likely to be successful.

"Attitude"[2] change occurring as a result of inefficient responses have commonly been referred to as changes in "soft core" attitudes. The term soft core is used to identify the amount of commitment or ego involvement (for the strict S-R theorist, the strength of the bond), the organism has for the response. Inefficient responses have low commitment values. Remember, however, that efficiency and inefficiency are self-defined. A response may appear inefficient to all but the organism producing it.

The second process of "true attitude change" involves changes in the

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[2] Note that attitude here refers only to the association bond between meaning units and behavior units and not the motivational sets.

motivational system. This process can occur in two ways. First and less likely the motivational system can be extinguished. In the individual this extinction is possible through classical procedures only with post-formed motivational systems. The deletion will occur only over a very long period of time or under severe crisis conditions (mental breakdown). Extinction of a pre-formed system can occur but only in the species through evolutionary processes. Pre-formed systems may be rendered inoperable by disease, lesion aging, and so on but this is not extinction as the term is used in S-R theory.

The other change that can occur in motivational systems is to change the conditions of reinforcement. The model states that behavior is engendered by specific deprivation states in the motivational systems. Each of these deprivation states requires a specific physiological condition to exist for its reinforcement[3]. The mature organism has developed a set of behavioral responses both indigeneous and learned to produce those conditions. Change the pre-conditions for reinforcement and the behavioral responses will change as the old set will no longer be adequate. Changes in the reinforcement conditions appear to require changes in the motivational system. These changes seem possible by the development of links between systems or the attachment/-detachment of "association" neurons which result in different requirements. These latter changes can occur as a result of changes in the environment which prevent the production of a response or demand the production of additional responses. Such changes would respectively result in the detachment of associational neurons through atrophication or the attachment of associational neurons to effiently motivate the additional responses required. Of course,

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[3]This requirement naturally includes so-called "psychological" needs since all functions of the organism are physiological.

similar changes might occur as a result of physiological changes in the organism due to accident, disease, age, or various abuses[4].

We have identified four processes which can be identified as attitude change:

1) Shifts in the dominance alignment of the motivational systems operating in a given motivational set. These shifts may result internally from changes in deprivation states as the dominant system achieves satiation and a new system comes to the fore. These shifts may also be the result of changing internal and/or external environmental information which are interpreted by the CPA as raising the probability of satisfaction for some system competitive with the then prime mover. These processes result in no structural changes in the motivational systems or response hierarchies, but only the observable behavior is changed. A toy car may go forward or in reverse depending on the position of a hidden switch. The "observable behavior", although perfectly consistent with the internal structure of the machine, may appear totally unpredictable. Most changes in behavior are the result of dominance shifts.

2) Restructuring of the meaning unit (interpreted stimuli set) behavioral unit association bond. The mature organism has devised behavioral sets to deal with his motivational conditions. Further the organism structures his environment (through societal, cultural, and individual processes) to provide a predictable set of stimuli. Given a set of stimuli interpreted according to the motivational set the organism has available behavioral solutions. When the stimulus-response-reinforcement chain is fitted well, the passage from stimulus to response becomes very efficient--habitual we say. The strength of the habit is a function of its efficiency. The more

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[4]If it is true that alcohol kills brain cells, can the result be the motivational changes observed in the alcoholic?

efficient the response the stronger the bond and the less likely is change to occur. Inefficient associations, however, are amenable to change. Inefficient responses generally result from the following conditions. a) Organism has had little experience with the particular requirements (usually external) and simply uses the closest approximation existing in his repertoire; b) Requirements are highly variable, inadequately displayed, and/or contradictory; c) Operating motivational systems are competitive; d) Dominant motivational system demands specific response difficult to produce; e) Old response is no longer available.

Examples of these conditions readily come to mind: a) The new driver of a foreign car attempts to use the familiar manual gear shifting pattern to find reverse--and fails. b) A teacher in attempting to motivate a new class of students is faced with a bewildering array of requirements. In fact, most social conditions contain these difficulties. c) A worker changes shift time and is forced to work when sleepy and sleep when awake. d) Responses difficult to produce are those with a large number of sub units, precise sequencing, requirements of peak output, and/or contingencies outside the direct control of the organism. In the last case, in the whole family of response calling for the assent of other organisms such as consensual sexual intercourse, business contracts, publications in review journals (see also condition "b"). e) The county clerk for whom you have voted for the past four elections has retired.

The probability of change under any of these conditions, is a direct function of the strength of the motivational system and, as noted, the inefficiency of the response. Fashion, social products (personal soap, perfume, after shave lotions, etc.), and those products whose result is to be judged by other (e.g., laundry products, household cleaning products, suburban lawn tractors, and, for many, automobiles) are all responses highly susceptable to

change when they are used to produce adequate reinforcement for the major motivational systems of sexual activity and approval. The promised inundation of sexual offers upon wearing some after shave lotion or perfume rarely occurs. Yet, if that is the basis (however scaled down) for the response, then reinforcement can only be incomplete. As long as the individual perceives the perfumed lotion as being a key to sexual success and as long as the promise of the product exceeds its performance, rapid change among specific products is likely.

Voting per se seems to be a motivated behavior while voting for a candidate seems a solution for the motivation to vote. This analysis seems particularly useful in dealing with the party voter and the so-called independent. The hard line party voter has no decision to make in partisan balloting other than whether to vote at all. Issues and candidates are essentially irrelevant as party label is the deciding characteristic. He is motivated to vote a party. His motivational system is more efficient than the (true) independents' who is only motivated to vote. Candidates can be "merchandized" with the independent but not with the partisan voter.

Changes in the response associated with the meaning unit do not affect the motivational system. They only effect the solution to the motivational problem presented. Consequently they make little change in the "psychological status quo" of the individual and can be accomplished with relative ease.

More difficult and complex changes are required in the next two processes of attitude change. Both of these processes change the structure of the motivational system.

3) Extinction of motivational system. This process involves only the post-formed systems. The term extinction is generally applied to conditioned responses where reinforcement is withheld until the response has a very low

position in the hierarchy. If, however, we postulate the development of "secondary drives" through conditioning processes, we appear to be required to allow their extinction. Nevertheless, it is generally easier to speak of response changes (the extinction of response A and the development of B) than the extinction of motivational systems. For example, a young man may perceive wealth as the solution to the drive for approval. Presuming he is like most of us, he finds wealth difficult to maintain. Consequently he seeks approval through community action. His response has changed but his motivation has not. The significance of this difference appears when we want to increase that individual's community action. We do so by depriving him of approval through other responses and publicly recognizing his community activities. Without knowing the motivational system operating, we cannot structure appropriate deprivation and reinforcement.

4) Restructuring of motivational systems. It seems reasonable to assume that if motivational systems can be built, these systems can be changed. Further, though we restricted extinction to post-formed structures, changes appear possible in both indigeneous and later developed systems. Positive changes seem possible by the consistent association of a response or set of responses with the reinforcement of a particular system. The motivational system over time would then begin to motivate that response set directly rather than being dependent on other stimulation. Extinction processes would instigate negative changes.

A B S T R A C T

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LEGEND

Letters (unsubscripted and subscripted) refer to the letters on the diagram.

A. The motivational systems 1) set the activity level of the organism; 2) establish the conditions for reinforcement (A1); 3) define acceptable activity through pre-setting actions. The pre-setting actions include 1) pre-setting the relay agents and memory to pass information relevant to deprivation states (A2); 2) raising the probability of certain responses (A3); 3) pre-setting the appropriate reinforcement agents (A4).

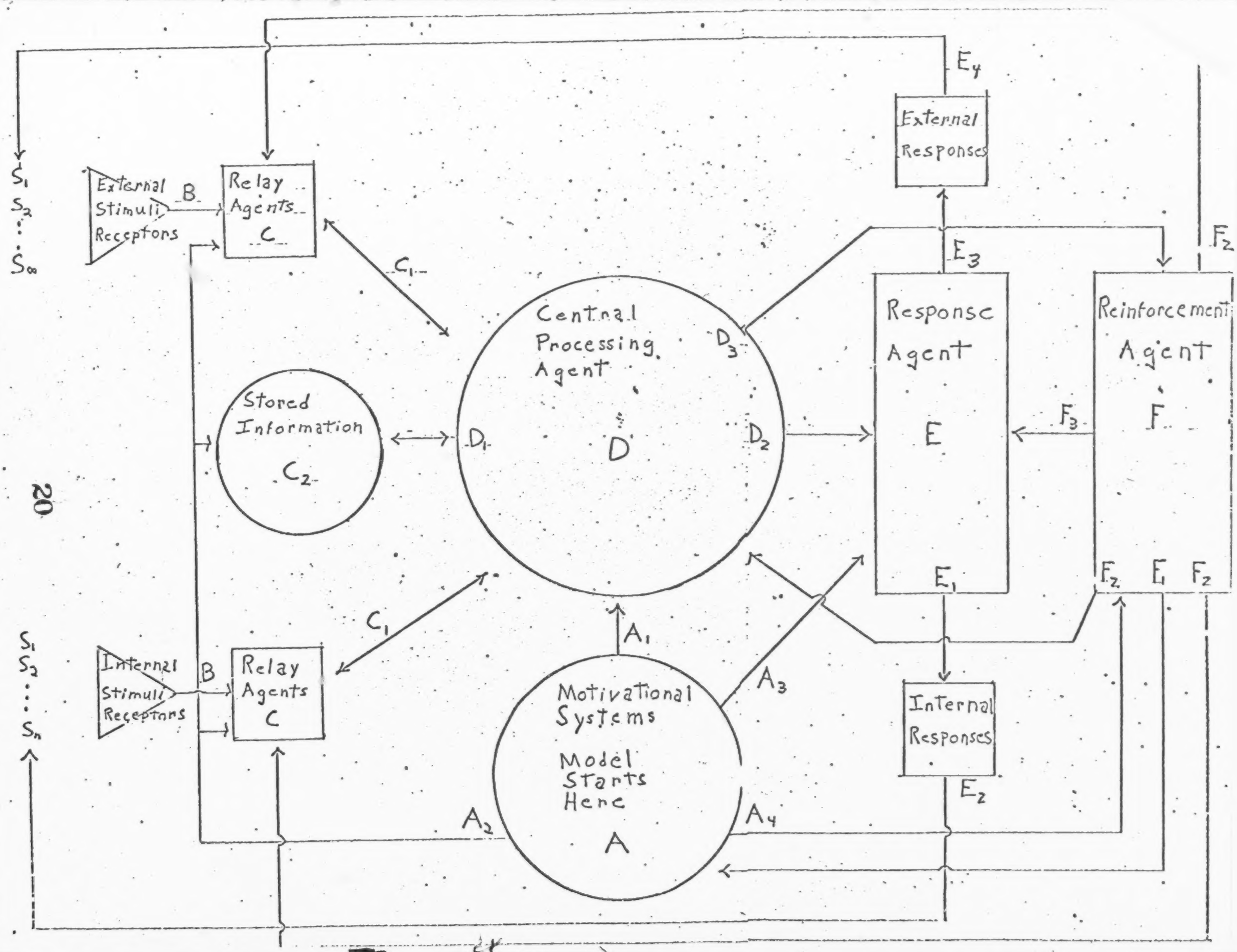
B. Information received by the stimuli receptors is initially chunked (many receptor cells feed into a single fiber) and passed on to the relay agents.

C. Relay agents determine the position of the information on the continua of Known--Unknown, Positive--Negative, Relevant--Irrelevant, in the primary identification process. Afferent and efferent connections (C1) exist between the relay agents and the central processing agent. These connections allow CPA monitoring of relay agents. Memory (C2) has information sorted according to pre-set requirements. These actions establish the context that information will be interpreted.

D. Central processing agent receives information and compares it to the demands of the motivational systems, then completes the meaning of the information by initiating storage (D1)--short term and/or long term--and responses (D2) or reinforcement (D3).

E. CPA cues (D2) appropriate response from the response agent. Behaviors are stored in molecules and compounds sorted in hierarchies. Responses are internal (E1) and external (E3). Internal responses form stimuli for internal stimuli receptors (E2). Response are evaluated for own sake. External responses also form stimuli for external stimuli receptors (E4). Each response carries expectations of results.

F. CPA cues (D3) reinforcement agent that requirements for positive reinforcement have been met. Reinforcement agent reinforces 1) the motivational systems (F1) through reduction of deprivation states; 2) the CPA and the relay agents (F2) increasing the likelihood that similar information will be handled in the same way and 3) the response agent strengthening the bond between the meaning unit (interpreted stimuli) and the behavioral unit.


S_1
S_2
S_∞
External Stimuli Receptors
B
Relay Agents
C
C_1
External Responses
E_4
E_3
F_2
Central Processing Agent
D_3
D_1
D
D_2
Stored Information
C_2
Response Agent
E
E_1
F_3
Reinforcement Agent
F
F_2 E F_2
A_1
A_3
Motivational Systems
Model Starts Here
A
A_2
A_4
Internal Responses
E_2
Internal Stimuli Receptors
B
Relay Agents
C
C_1
S_1 S_2 ... S_n